

SHORTER COMMUNICATIONS WET-FIELD TARO TERRACES ON MANGAIA, COOK ISLANDS

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In the triad of great Pacific food plants, taro, sweet potato and yam, the taro holds a place of particular significance. One of the most ancient cultivated plants in the Indo-Pacific region, *Colocasia* became associated with garden magic and with the rituals of the cycle of procreation and the perpetuation of life throughout Polynesia and Melanesia. ¹ It is perhaps, therefore, not surprising that as the old Pacific cultures disappear and are replaced by the new, the dominance of the taro and the techniques and practices which enabled its cultivation far from the humid tropical environment of Asia should also decline and disappear.

Across the Pacific, taro terraces lie abandoned, their irrigation systems fallen into disuse and decay. Taro cultivation has disappeared from Viti Levu in the Fijian Islands ² and is declining on the outlying islands. ³ In New Caledonia, where terrace systems reached “the highest degree of perfection”, ⁴ the practice is found only in isolated parts and on outlying islands. ⁵ The great Hawaiian terrace systems rapidly followed the pre-contact society into disarray; lack of water and introduced rice cultivation displaced large areas of taro as early as 1860. ⁶ On Tahiti, the terrace systems appear to have been in a decline even before European contact, ⁷ and are non-functional today. In the more isolated Cook Islands, there is also a decline in taro cultivation; on Rarotonga, almost all the ancient stone-walled terraces and water races in the valleys are abandoned and cultivation is restricted to the swamps of the coastal zone.

Despite the former dominance of taro in Pacific agricultural systems, techniques and practices of cultivation and irrigation are poorly documented. Both Spencer and Hale, ⁸ and Wright ⁹ note that there has been little study of Pacific terrace systems. This paper is restricted to a brief description of the wet-field terraces on the island of Mangaia in the Southern Cook Group. It is based on incidental notes taken during research on a broader topic, ¹⁰ but because the wet fields on Mangaia are possibly the last of their extent still in use in the Pacific and because they too are in a state of decline and deterioration, the notes are felt worthy of reproduction.

The Mangaian Terraces

Mangaia is located in the centre of the South Pacific, 114 miles south-east of Rarotonga and is 12,828 acres in extent. The core of the island is a low (554 feet) basaltic dome eroded into a series of deep, radial ridges and valleys. Completely surrounding this volcanic core is the *makatea*, a coralline limestone structure between one and two miles in width and 180 to 200 feet above sea level on its surface. Along much of the inland edge of the *makatea*, sheer cliffs have been formed and only occasionally does a ridge of volcanic material run up against the limestone collar. The *makatea* surface is intricately eroded and pitted with only a few small pockets of soil suitable for cultivation. The inland hill soils are laterites which support only low fern and stunted *Casuarina* trees. The lower hill slopes are more fertile, but before European contact were uncultivated. A narrow fringing reef encircles the whole island, with deep water close in shore. The island receives a mean annual rainfall of 77 inches and, although there is a dry season, droughts are not normal.

The Manganian terraces have been developed between the *makatea* wall and the heads of the inland valleys. Streams running from the centre of the island lie in narrow, steeply graded valleys, until, about three-quarters of a mile from the *makatea*, they enter broad, gently sloping valleys. At the bottom of the valleys, swampy areas have formed where the streams pond against the limestone cliffs of the *makatea*, before reaching the sea through subterranean channels. There are seven main stream networks, and each network and catchment has a terraced wet-field system developed on it (see Figure 1). In all, approximately 310 acres has been terraced and irrigated, although not all of this is in use.

On each catchment there are three distinct forms of irrigated wet-field. In the upper valleys, where stream gradients are steep, sills and dykes of volcanic rock outcrop into stream beds, causing local base levels to be established in association with falls and rapids. The terrace systems here comprise single flights of terraces parallel to the stream and some feet above the stream bed. An artificial channel leads water into the top terrace of a flight, from where it flows down through successive levels, controlled by small wooden gates. Depending on the distance between rock outcrops and the width of the valley floor, there may be from 5 to 20 terraces in a flight. Most of the upper valley terraces have been abandoned and only those in Keia District and some in Tava'enga remain functional (see Figure 1).

The terrace system in the middle valley consists of a series of low earthen-walled embankments which have been constructed across the valley floor. On the level areas created, a series of wet-fields and beds have been formed. Water control appears deceptively simple. A dam, just before the main stream emerges from the upper valley, diverts water into two or three artificial channels, or *matavai*, which are about 6 feet deep and 3 feet wide and run down both sides of the valley, along the edge of the terrace system. In a number of places *matavai* also run through the centre of the terraces. Because the successful cultivation

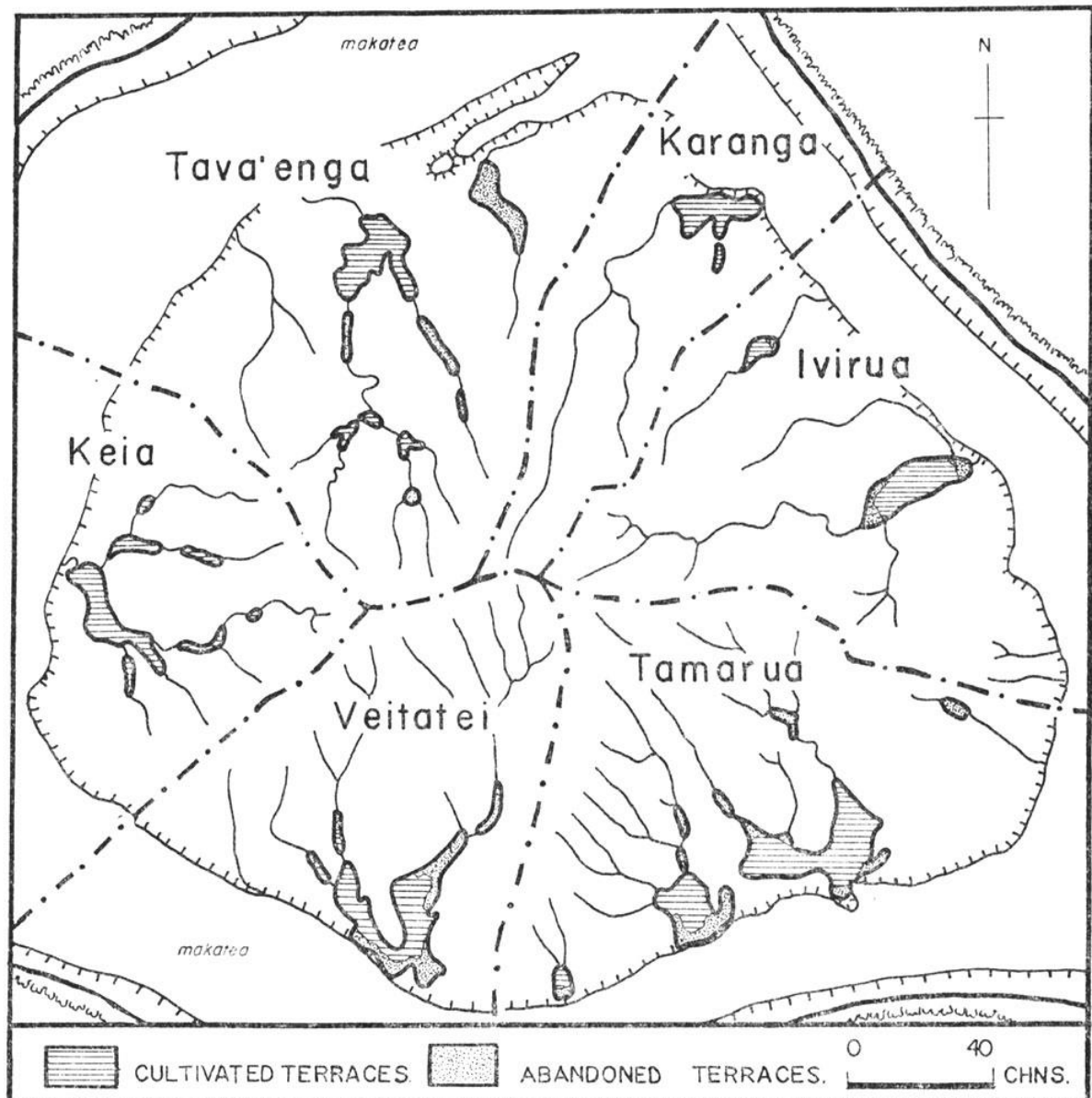


FIGURE 1

Wet-field taro terraces on Mangaia

of taro depends upon the continual circulation of water through the plot more than upon the gross amount of water available, the system is designed to move water through each level rather than merely deliver it to a terrace level.

On the lowest terraces, gradients are negligible and excess water accumulates. The *matavai* become larger here and function solely as drains. This part of the system closely resembles the coastal taro swamps of Rarotonga, and the swamps of Atiu. From the base of the terraces the water is allowed back into the old stream bed to disappear beneath the *makatea*. Since it is important that no water should be impounded or allowed to stagnate, the construction of the terraces, the establishment of correct levels and the adjustment of water flows would have created some initial engineering problems. Once constructed, the systems depend on the regular maintenance of channels and bunds more than upon any complicated water management techniques. Figure 2 illustrates the layout and water reticulation within the larger of the two terrace systems in the Tamarua District, on the southern coast of the island.

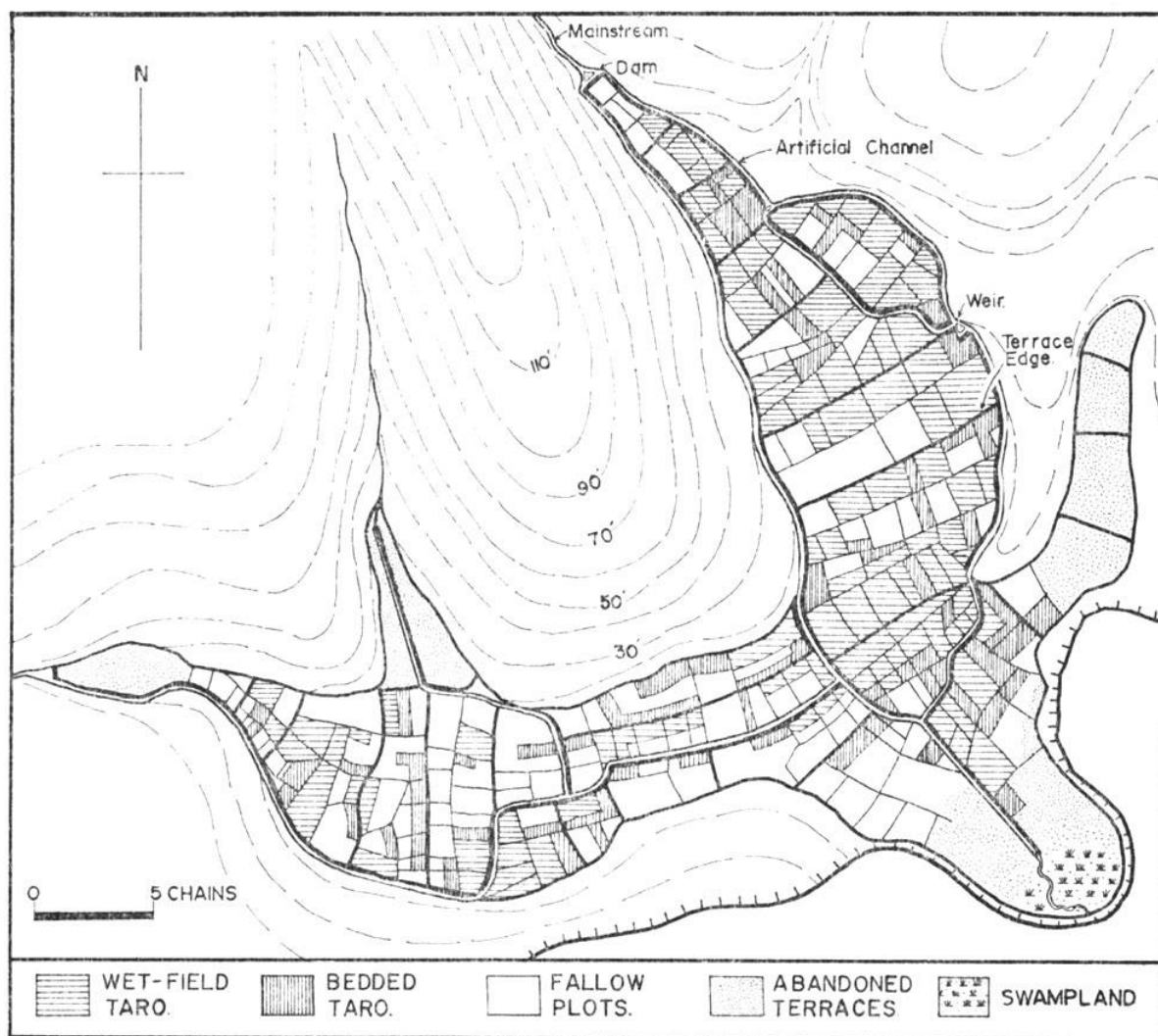


FIGURE 2

Tamarua terrace system, Mangaia

Within the taro fields there are two forms of enclosure: the true wet-field enclosure in which is grown a smaller and finer variety of *Colocasia*, locally called *mamio*, or *taro vai*, and the raised bed for the cultivation of the larger *taro pa'i*.

The *mamio* plots tend to be symmetrical in shape, and between 30 and 60 feet a side. Bunds are about 2 feet high on all sides. The *pa'i* beds are constructed within a bunded enclosure in the middle terraces, but, on the lower terraces, are often unenclosed. A bed is formed by opening a ditch around the edge of the plot and throwing the material excavated into the centre of the plot. *Pa'i* beds are rectangular and form strips within the terraces rather than true plots. Figure 2 shows the relationship between *mamio*, *pa'i* and fallow plots in the Tamarua system. All plots appear to be of pre-European construction and no new plots are constructed, although some old plots are renovated for re-use.

Planters rarely use all the plots to which they have rights, and on average, one in every four plots is fallow. Cropping, which is carried on continuously for between four and six years, is

followed by an indefinite period of fallow, during which the plots are rapidly covered with swamp grasses and weeds. A *mamio* plot is cleared by removing this mat of vegetation with a bushknife, an arduous job which involves working at thigh depth in mud and water. The fallow vegetation is cut into blocks and thrown up on to the surrounding bunds where it rots and assists in maintaining the bund structures. This work is usually undertaken by a group of men who assist each other in turn, but one man alone can clear about 180 square feet in one hour. Once the plot is cleared, the bunds are checked, the control gates repaired and the plot is blocked off to allow the fine silt and mud to settle to the bottom.

Usually the tops of mature tubers are planted, but sometimes shoots from old tubers left growing beyond maturity are used. (Karanga gardeners claim to have produced a new variety by this method.) The tops are pushed gently into the mud beneath the water in rows about a foot apart. As soon as the mud has resettled, water is allowed to move through the plot. Few plots are completely planted at once, but are planted in stages to lengthen the period of harvesting; planting takes place all year round. Weeding, although tedious, is not difficult, but must be done regularly as weed growth is rapid and will quickly spoil the young tubers. Weeding is done by women.

Pa'i is cultivated in a manner similar to that described by Barrau for Atiu. [11](#) The bed is cleared, dug over, covered with a grass or coconut frond mulch, and left for up to 2 weeks. Tops are planted with the use of a wooden torpedo-shaped tool, *pau*, which pushes holes in the soft soil without disturbing the mulch. Weeding is not normally needed more than once. The tubers take between 6 and 8 months to mature.

The bulk of all food consumed on Mangaia (including imported food), comes from the terrace systems. In 1967, of the 208 acres of land under subsistence cultivations, 176 acres were wet taro and only 32 acres dry-land gardens such as *tarua*, kumara, yam, bananas or combinations of these. There were 59 acres of fallow wet-field plots. [12](#) The predominance of wet taro is reflected in other ways. In a sample of 91 gardeners, the heads of households, there were cumulatively 702 plots of wet taro cultivated, compared with 109 plots of other food plants (see Table 1). In the district of Karanga, where a village *tutaka* (inspection) allowed total population figures to be collected for one complete terrace system, 54 households were cultivating 466 plots of wet taro, an average of 8.6 plots per household (S=5.5 plots).

TABLE 1 Garden Plots Cultivated, Mangaia, 1967

Type of Crop	Number of Plots	Percentage of Total Number of Plots in Sample	Percentage of 13 Total Number of Gardeners in Sample
Wet taro (<i>Colocasia</i>)	702	86.4	100.0
Tarua (<i>Xanthosoma</i>)	37	4.5	30.7
Ku'ara (<i>Ipomoea</i>)	5	0.6	5.4
Maniota (<i>Manihot</i>)	6	0.7	6.5
Yam (<i>Dioscorea</i>)	11	1.3	10.9
Banana (<i>Musa</i>) 14	21	2.5	20.8

That wet taro provides a substantial portion of the Mangaian diet is further indicated by the results of a survey of meals consumed over a month by six adolescent school children and one adult male. Of the 536 meals, 248 or 46 percent contained wet taro and a further 11 percent contained *rukau*, a preparation of boiled taro leaves resembling spinach. Wet taro was eaten more frequently by these persons than any other food, local or imported.

Deterioration of the Wet-Field Terraces

There are a number of indications that the terrace system is deteriorating. Some areas have been abandoned, including one complete system in Tava'enga and most of the upper valley flights. Those parts of the terraces which remain in use are not being maintained; older informants noted that the bunds and paths were much more overgrown with grass and shrubs than was so 20 years ago. Damage to bunds and water channels occurs more frequently now, weakening other parts of the system.

The abandonment of some terrace areas took place over 70 years ago. Only the oldest villagers could recall taro being cultivated in the now abandoned Tava'enga area, for example. It is likely that the removal of settlements from the areas surrounding the terraces to the coast some miles away, under missionary influence, was the first disturbance of the system. The increased effort and time required to reach the least accessible parts of the terraces would increase the probability of their abandonment.

More recently, further abandonment has taken place. Aerial photographs of 1945 show that the upper areas of all terrace systems except the Keia system (nearest to Oneroa, the largest settlement) have been invaded by scrub and tall reeds. During the past 20 years, a more stable form of cash cropping has been established, monetary incomes have increased, emigration to New Zealand has risen, and there has been increased contact with the modern world. All these factors appear common wherever wet taro cultivation is in decline, but to see them as a direct influence is to oversimplify the process. There has been neither a simple reorientation of labour to cash cropping, nor a reliance on a less labour intensive subsistence crop, such as manioc. ¹⁵ On Mangaia, and possibly in other Pacific territories, the decline of agricultural systems which were closely integrated with pre-contact social structures is related to the inability of the society concerned to maintain the systems during periods of rapid social and economic change.

The wet-field terrace systems are comparable to natural drainage basins, as analogous relationships occur between factors such as flow and volume of water, load, erosion, sedimentation and fertility. The equilibrium state which evolves in natural drainage basins over long periods of time is comparable with the engineered quasi-equilibrium state of the terraces, which allows the maximum movement of water for the minimum loss of solid material and fertility. It is a much more delicate balance of forces, however, than that which occurs in a natural system and can be achieved only by constant maintenance of terraces, water races and dams, as well as the surrounds of the wet-fields. A deterioration of one part of the system is quickly felt in other parts; a washout, for example, will rapidly result in a line of broken terraces down the valley with the accompanying loss not only of plants but also of years of accumulated soil and fertility.

The pre-contact society evolved a system of reciprocal and obligatory relationships which ensured the maintenance of the terraces and the supply of food to the society. Family heads claiming rights to taro land were obliged to supply labour to public works parties, which ascribed authorities had the right to call, and gardeners were expected to keep their plots clean of weeds and the bunds and races near their plots in good order. Failure to comply brought strong social pressures upon individuals and families, with the additional risk of the loss of rights of occupancy to individuals. Although traditional leaders lost some prestige following the establishment of the mission in 1845 (Tahitian pastors were in residence from 1823 to 1845), they remained able to administer their traditional duties, and in some instances their influence was strengthened by the introduction of severe punishments under mission “law”.

Increased contacts with material goods and a monetary economy, brought about by a more intense entry into the New Zealand metropolitan market and by emigration since the Second World War, have induced a second period of rapid change in Manganian society. The old multi-functional social structures which survived the mission impact are being eroded away as new and more specialised structures evolve, or are being supplied by a benevolent administration. The family, for example, has lost many of its former social and economic functions, with a subsequent decline in the power of its former sanctions and a reduction in the direct control of family heads. As each link in the ascribed chain of command weakens, traditional leaders become less able to carry out their responsibilities. In 1967, their activities were restricted almost solely to settling land disputes and, although they were accorded respect in public, many informants expressed a lack of confidence in their leadership. In discussing the problem of the terraces with traditional leaders, it became apparent that rather than risk a failure in public they were prepared to restrict their activities to an area where they held specialised knowledge not available to other members of the society: namely, the administration of the land tenure system. [16](#)

Non-traditional administrative bodies, such as the Island Council, are empowered to raise labour or to levy taxes for the construction and maintenance of roads and tracks or the boat landing, but they have no stated jurisdiction in the upkeep of the terrace system, and appear to have no interest in its functioning. The terraces have always been within the traditional spheres of authority, and there is, at present, no new organisation to replace the hiatus created by the cessation of the activities of ascribed leaders. In only one village, where a local politician also held a ranking title, was an effort being made to repair and upgrade the terrace system.

All interviewees were asked whether they could see themselves ceasing to grow taro in favour of cash crops such as pineapples. All answered no, and many added that such a suggestion was “silly” because then they would have to pay for their food with money. A number also pointed out: “you cannot be a man if you do not grow taro”. Work diaries indicate that, in general, Mangaians spend more time in fishing and cultivating subsistence crops than they do in cash cropping. The most productive cash croppers all had other occupations, all but one as government servants. Thus, cash cropping cannot be said to be competing for labour with the wet fields. It is possible to argue that selective emigration is reducing the overall supply of labour as, in 1951, 47 percent of the total population were aged between 15 and 59 years, whereas in 1966 this age group comprised only 37 percent of the total population. The 0 to 14 years age group has increased from 48 percent to 57 percent over the same period. On the other hand, there has not been a marked change to a less labour-

demanding subsistence crop such as manioc (Table 1). The taro fields are labour-demanding for only short periods and most of the light work is done by women.

Nevertheless, the decline in the terrace systems continues. The major reason seen for this decline is the withdrawal of the ascribed authorities from the administration of the system and the lack of any replacement body. The society has not yet become sufficiently reintegrated to produce new leaders who can carry their influence into traditional areas, as well as non-traditional areas. Because the old leaders remain nominally in position, new leaders are forced to find their positions on the Island Council or the Pineapple Growers' Committee, thus maintaining the severance of relationships between the society and the environment.

Two further points may be made as a postscript. The first is that even if the deterioration of the terraces continues beyond the point where restoration is practicable, they have given the community an important stability during a period of general instability, by making possible the continued production of a traditional staple of good quality, thereby avoiding the importation of expensive less nutritious foods or the cultivation of a poorer quality subsistence crop, and by providing a culturally satisfying, meaningful, traditional occupation.

The second point is a plea for the terrace systems to become the subject of an investigation by agricultural extension workers in the Cook Islands. As Rarotonga and Aitutaki prepare for tourist trade, it is foreseeable that both islands will experience a shortage of locally grown subsistence crops. Mangaia has the potential to supply internal markets within the group, as well as New Zealand markets created by the swelling numbers of islander immigrants. For too long in the Cook Islands, extension work has concentrated upon commercial crops to the detriment of subsistence crops.

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[1](#) Barrau 1965.

[2](#) Ward 1965:205.

[3](#) Sahlins 1962:43-9.

[4](#) Barrau 1958:21.

[5](#) Doumenge 1966:327.

[6](#) Morgan 1948:165.

[7](#) Lewthwaite 1964:18.

[8](#) Spencer and Hale 1961.

[9](#) Wright 1962:97.

[10](#) Allen 1969.

[11](#) Barrau 1961:14, 21, 26, 27.

[12](#) Tomato gardening for cash became integrated with the existing subsistence rotational fallow system and subsistence garden fallows cannot be distinguished from old tomato gardens. Tomato gardening had ceased on Mangaia in 1967.

[13](#) N=91. Survey carried out May to August.

[14](#) Banana plants are especially ubiquitous. This figure represents only pure garden stands.

[15](#) These are two explicit reasons given by Sahlins for the decline of wet taro on Moala. See Sahlins 1962:49.

[16](#) Although the Cook Islands Land Court has the same jurisdiction on Mangaia as on other islands in the group, Mangaian leaders have steadfastly resisted any investigation of titles or surveying on the island.